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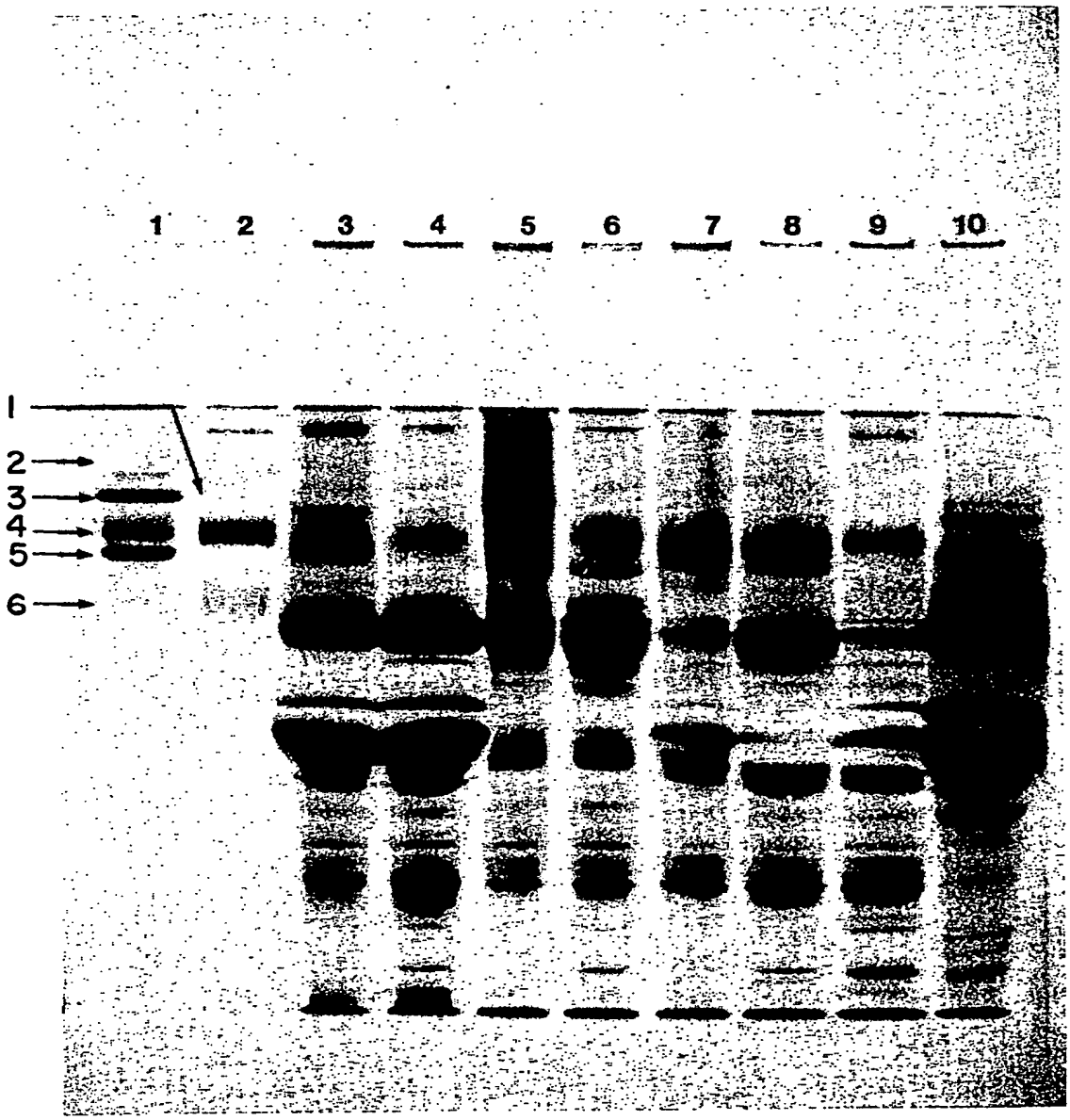
(54) Whey protein

(57) A proteinaceous material obtained from milk or casein-containing milk products, or an analogue or derivative thereof, comprises a polypeptide or mixture of polypeptides substantially free of native alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins, and

i) remains in solution at pH 4.6 to pH 5.3 at 20°C;
ii) is anionic at pH 4.6 to pH 5.3; and
iii) forms a gel when an aqueous solution containing at least 12% w/v of the proteinaceous material at 20°C and pH 4,5 or below is allowed to stand for 18 to 24 h.

Milk whey at pH 4 to 6 may be contacted with an anion exchange resin, the resin may be eluted with HCl or NaCl and the product may be concentrated by ultrafiltration or thermal evaporation and/or spray dried or freeze-dried.



LEGEND

1. BOVINE SERUM ALBUMIN
2. κ – CASEIN
3. β – CASEIN
4. α – LACTALBUMIN
5. α – CASEIN
6. β – LACTOGLOBULIN

Fig.1.

SPECIFICATION

Whey protein

The present invention relates to a novel proteinaceous material which may be obtained from milk or casein-containing milk products, to processes for its production and to its use as a thickening, gelling, emulsifying, stabilising or whipping agent or as a protein supplement in food or drink products, especially dairy products.

Milk is known to contain a number of proteins, the major ones being alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins. Various methods are known for obtaining these proteins, such as those described in UK Patent No. 1563990 and Chemistry and Industry, 7 November 1983, pp 810-814 which relates to processes for fractionating the proteins in whey by anion exchange chromatography.

It has now been found that a proteinaceous material having previously unrecognised physical properties may be obtained from milk and certain casein-containing milk products by extraction procedures involving anion exchange chromatograpy and that these surprising properties enable the material to be used as a thickening, gelling, emulsifying, stabilising or whipping agent for food and dairy products.

Accordingly the present invention provides a proteinaceous material obtained from milk or casein-containing milk products, or an analogue or derivative thereof, comprising a polypeptide or mixture of polypeptides substantially free of native alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins, and which

i) remains in solution at pH 4.6 to pH 5.3 at 20°C;
ii) is anionic at pH 4.6 to pH 5.3; and
iii) forms a gel when an aqueous solution containing at least 12% w/v of the proteinaceous material at 20°C and pH 4.5 or below is allowed to stand for 18 to 24 h.

As used herein the term "analogue" encompasses proteins having an amino acid sequence which are the same as or related to the amino acid sequence of the proteinaceous material and are obtained from dairy sources or produced by other means including total synthesis and by DNA recombinant techniques and the term "derivative" includes protein obtained from milk or casein-containing milk products or analogues or such protein which have been chemically or enzymically modified.

As used herein the expression "substantially free of native alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins" means that the proteinaceous material contains less than 5% w/w of the total dry protein weight of any one of these proteins in its native form. Preferably the total amount of these proteins is less than 5% w/w, and most preferably the material of the invention comprises less than 1% w/w of each of these proteins as determined by quantitative polyacrylamide gel electrophoresis as described by Anderson and Andrews (Journal of Dairy Research, (1977), *44*, 223-235) and Hillier (*ibid.*, (1976), *43*, 259-265).

The proteinaceous material of the invention is novel since at acid pH values it is capable of producing significantly more viscous solutions and/or stronger gels than known milk protein fractions.

Proteinaceous material according to the present invention is usually obtained from dairy sources such as milk or whey, for instance, whey resulting from acid precipitation of curd, rennet casein whey and cheese-whey, and in such cases will often comprise a mixture of polypeptides. It is believed that a part of this mixture is present in milk and proteinaceous material produced from whey resulting from acid precipitation of curd is likely to be particularly rich in this component. It is also believed that part of the proteinaceous material derives from the action of proteolytic enzymes on casein, especially kappa-casein, and material derived from rennet or cheese-whey is likely to be richer in this component. A further useful source of the proteinaceous material is casein or caseinate, preferably sodium caseinate, which has been treated with proteolytic enzymes such as rennet; again this is likely to be rich in the casein-derived component. Preferably the proteinaceous material is derived from cow's milk or casein or caseinate obtained from cow's milk.

The present invention therefore provides a process for producing a proteinaceous material as defined above which comprises fractionating milk whey or a casein-containing milk product which has been exposed to proteolytic enzymes and recovering fractions containing a polypeptide or mixture of polypeptides substantially free of native alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins and which

i) remains in solution at pH 4.6 to pH 5.3 at 20°C;
ii) is anionic at pH 4.6 to pH 5.3; and
iii) forms a gel when an aqueous solution containing at least 12% w/v of the proteinaceous material at 20°C and pH 4.5 or below is allowed to stand for 18 to 24 h.

Preferably fractionation is effected by anion exchange chromatography using an ion exchange medium bearing basid functional groups.

In one embodiment the process for producing the proteinaceous material comprises the steps of

(a) if necessary, adjusting the pH milk whey to pH 4 to 6
(b) contacting the whey with an ion exchange medium having basic functional groups
(c) eluting protein fractions from the medium
(d) collecting the fractions containing the desired polypeptide or mixture of polypeptides
(e) removing excess eluant from the fractions so obtained and
(f) drying the proteinaceous material so produced.

The whey used in the process may be obtained by any conventional method such as acid or, preferably, rennet coagulation of fresh milk preferably cow's milk. Conveniently the whey is separated to remove residual fat before being acidified.

Whilst it is not essential it is much preferred that, either before or after the pH adjustment step, the whey

is pasteurised, for instance at 65 to 76°C, preferably at about 72°C, for 10 to 25 seconds, preferably about 15 seconds, and is then centrifuged to remove any protein precipitate. The proteinaceous material obtained when such a pasteurisation step is included has been found to provide substantially stronger gels than when this step is omitted.

The pH of the whey is adjusted if necessary, in conventional manner, to pH 4 to pH 6, preferably to pH 4.5 to 5.5 and most preferably pH 4.8 to 5.0.

The pH-adjusted whey is then passed through an ion exchange medium having basic functional groups which bind the polypeptide(s) in question. Preferably the ion exchange medium has strongly basic functional groups. Suitable ion exchange media are Spherosil QMA (Rhone-Poulenc Fine Chemicals), Amberlite IRA 958 (Rohm and Haas Ltd.) and Indion QAE cellulose (Waitaki Refrigeration Co. Ltd.), ("Spherosil", "Amberlite" and "Indion" are Trade Marks). With these media the preferred throughput of whey before regeneration of the medium is of the order of 10 times the bed volume of the medium.

Unadsorbed protein and non-proteinaceous components are washed from the medium using water.

The proteinaceous material of the invention is then recovered from the ion exchange medium by eluting with eluants of suitable ionic strength and pH, for example hydrochloric acid, preferably 0.1 to 0.2 *M* hydrochloric acid, or an alkali metal chloride, preferably sodium chloride, most preferably 1 *M* sodium chloride. The properties of the final product differ slightly according to which eluant is used.

Conventional ion exchange or chromatographic techniques for continuous, semi-continuous or batch production may be employed.

The eluate is collected and some of the excess eluant is removed and the proteinaceous material is concentrated. Conveniently this is achieved by ultrafiltration and the ultrafiltratioin membrane system may also be used to reduce the concentration of eluting agents by diafiltration with water. Preferably the eluate is adjusted to higher pH, at least greater than pH 4.5 thereby permitting greater degrees of protein concentration without the problem of gellation during the concentration step.

Optionally the protein may be concentrated further by, for instance, thermal evaporation before drying, for instance by freeze or spray drying. Spray drying is preferred since the protein fraction so obtained has improved shelf life as a dry powder compared with freeze dried proteinaceous material. Suitably spray drying is conducted with an air inlet temperature of about 200°C and an outlet temperature of about 95°C.

In an alternative embodiment the process for producing the proteinaceous material comprises the steps

a) treating resuspended casein or caseinate with proteolytic enzymes,

b) adjusting the pH of the product of step a) to pH 4 to 6,

c) removing any precipitated protein,

d) if necessary adjusting the pH of the remaining solution to pH 4.8 to 5.3,

e) contacting the solution with an ion exchange medium having basic functional groups,

f) eluting protein fractions from the medium,

g) collecting the fractions containing the desired polypeptide or mixture of polypeptides,

h) removing excess eluant from the fractions so obtained and

i) drying the proteinaceous material so produced. Preferably step a) is conducted at pH 6.0 to 6.7 and 32°C for 1 hour using rennet.

When eluted using an acidic medium the proteinaceous material of the present invention does not precipitate over a wide range of pH but forms a strong gel in aqueous solution of 7% w/v or greater concentration at ambient temperatures provided the pH is about 4.5 or below. A 10% w/v aqueous solution of the proteinaceous material normally has, at pH 3.5 and 20°C, a viscosity in excess of 3000 mPa.s. Accordingly the protein fraction is useful for thickening or gelling acidic food and drink products, such as sauces, mayonnaises and low-calorie spreads and those subjected to acid and heat such as jams, jellies and heat-treated fruit-juice products.

At pH values over about 4.5 the proteinaceous material of the invention does not form gels. Under these conditions it finds applications as an emulsifying agent and as a protein supplement and may be used to avoid the precipitation problems that are encountered when total milk protein or sodium caseinate are employed. The proteinaceous material is also stable over a wide range of temperature and can be used in products subjected to heating when the addition of other whey proteins, such as beta-lactoglobulin, would cause gellation, provided that the pH remains above 4.5. Furthermore the proteinaceous material is able to stabilize foams in aerated products.

When eluted using a neutral salt-containing medium the properties exhibited by the material are similar to the above but, in general, higher concentrations are needed to achieve the same effect. Thus, for instance, a concentrate of at least 12% w/v is required at a pH of 4.5 or below to achieve a strong gel in aqueous solution.

The present invention thus provides a liquid or solid food or drink product comprising, as thickening, gelling, emulsifying, stabilising or whipping agent or as a protein supplement; a proteinaceous material as hereinbefore defined.

The invention also provides a process for thickening or gelling a food or drink product comprising admixing a sufficient quantity of a proteinaceous material as hereinbefore defined or an aqueous solution thereof with other ingredients of the food or drink product the aqueous phase of which has a pH of 4.5 or less.

The invention further provides a process for emulsifying or stabilising a food or drink product comprising admixing a sufficient quantity of a proteinaceous material as hereinbefore defined with other ingredients of a food or drink product the aqueous phase of which has a pH of over 4.5.

The invention further provides a process for producing an aerated food or drink product, for instance a milkshake or dessert whip, comprising admixing a sufficient quantity of a proteinaceous material as hereinbefore defined before or at the same time as the product is whipped or otherwise aerated to form a

foam.

Fig. 1 shows the results of polyacrylamide gel electrophoresis on samples of the proteinaceous material of the present invention (lanes 3 to 10) and of skim milk and whey (lanes 1 and 2).

The invention will now be illustrated by the following, non-limitative Examples:

EXAMPLE 1

Production of the Proteinaceous Material from Whey:

Whey produced from whole milk by rennet coagulation such as in cheese manufacture was separated to remove residual fat, acidified to pH 4.8 to 5.0, and pasteurised at 72°C for 15 seconds. It was then centrifuged to remove any protein precipitate. The whey was next passed to a column containing a porous ion exchanger with strong base functionality, (Spherosil QMA, Rhone-Poulenc). The throughput of whey was 18.5 litres per kg of dry medium. The protein was eluted from the ion exchanger using 0.1 *M* hydrochloric acid and collected.

The concentration of protein in the eluate was increased to 8 to 9% w/v of the total solids by ultrafiltration. The ultrafiltration equipment employed was a pilot plant supplied by Rhone-Poulenc which was fitted with 2.3 m^2 of UFP10A type membranes. The plant was operated at ambient temperature with inlet and outlet pressures of 3 and 2 bar respectively. The product was then diafiltered with freshwater to remove most of the remaining hydrochloric acid. The diafiltration was continued until the conductivity of the protein concentrate was reduced below a level five times that of the diafiltration water. The protein solution was spray dried using an air inlet temperature of about 200°C and an outlet temperature of about 95°C.

Properties of the Proteinaceous Material:

The proteinaceous material contains 95% total solids and 78% crude protein (total nitrogen x 6.38). In addition there is 3 to 5% ash and 1 to 2% fat. The major whey protein components: bovine serum albumin, alpha-lactalbumin and beta-lactoglobulin are absent or present at very low levels as determined by polyacrylamide gel electrophoresis. Polyacrylamide gel electrophoresis in the presence of 8 *M* urea gives rise to a number of protein bands as shown in Fig. 1 and discussed below.

The proteinaceous material contains a proportion of protein which is not precipitated by tri-chloro-acetic acid.

The acid stability of the proteinaceous material was demonstrated by making up 5% w/v aqueous solutions of (a) proteinaceous material, (b) sodium caseinate, and (c) a total whey protein isolate powders, adjusting the pH value of each solution to 6.5 to 7.0 and then running in small quantities of hydrochloric acid to reduce the pH progressively down to 1.5. Solution (a) showed an increase in turbidity from pH 5.5 to pH 3.5 but showed no sign of precipitation or instability. Solution (c), the total whey protein isolate, also showed marked increase in turbidity from pH 5.5 to pH 3.5 but the turbidity then reduced until the solution was almost as clear at pH 1.5 as it had been at pH 6.5. Again, there was no sign of precipitation or instability. Solution (b), the sodium caseinate, showed very heavy precipitation from pH 5.5. The precipitate began to redissolve from pH 4.0 but a proportion remained even at pH 1.5.

The temperature stability of the protein fraction was demonstrated by making up 10% w/v solutions at pH 6.5 of the three protein powders [(a) to (c) above], placing them in a shaking water bath and heating progressively up to 72°C where the solution of (c) formed a gel. The two remaining samples were heated up to 90°C. Both showed no indication of gellation, though the proteinaceous material showed an increase in turbidity and a slight reduction in viscosity.

10% w/v solutions of the three powders [(a) to (c) above] were made up at ambient temperature and pH adjusted to 3.5 using food grade hydrochloric acid. The viscosity, as determined by a Brookfield viscometer, of the proteinaceous material (a) was 3160 mPa.s compared to 20 mPa.s for sodium caseinate (b) and 30 mPa.s for whey protein (c). The proteinaceous material was shown to form firm gels when suspended in water at concentrations of 15% and at ambient temperature, but this phenomenon is restricted to pH values below 4.5.

EXAMPLE 2

The process of Example 1 was repeated except that the elution was conducted using 1 *M* sodium chloride in place of the hydrochloic acid eluant. This resulted in an increase in amount of protein recovered of approximately 30%.

The protein fraction thus obtained was similar to that obtained in Example 1. A 20% w/v solution in water at ambient temperature and pH 3.5 had a viscosity of 360 mPa.s (see below).

EXAMPLE 3

The process of Example 1 was repeated except that the pasteurisation step before contacting with the ion-exchange medium was omitted. The protein fraction thus obtained was similar to that obtained in Example 1.

The strength of the gel formed with 10% (w/v) solutions of the products of Examples 2 and 3 decreases with increasing time between the elution step and the final drying of the product, due to proteolysis by enzymes originating from the rennet used in cheese manufacture which are also absorbed and recovered during the ion-exchange process; the pH of the eluate is such that rapid proteolysis takes place. The problem may be overcome either by heat-treatment after elution to inactivate the enzymes or by adjusting the pH of the eluate to above 4.0. It has also been observed that less strong gels are obtained the longer this powder is held in storage and thus greater amounts of powder are required to achieve the same result.

EXAMPLE 4

The processes of Examples 1 and 2 were repeated except that whey obtained by acidification of milk to pH 4.6 was passed through the Spherosil ion-exchange medium at pH 4.8 to 5.0. Similar results were obtained except that the yield of protein per unit volume of whey passed through the medium was reduced by approximately 66% in each case.

EXAMPLE 5

The processes of Examples 1 and 2 were repeated except that instead of whey a protein-containing solution at pH 4.6, obtained by treatment of a 2.5%

(w/v) sodium caseinate solution in milk serum with rennet for 1 h. at 32°C at pH 6.65, was passed through Spherosil ion-exchange medium at pH 4.8 to 5.0. Similar results were obtained except that the yield of protein per unit volume of solution passed through the medium was reduced by approximately 33% in each case.

EXAMPLE 6

The processes of Examples 1 and 2 were repeated except that the whey was contacted with Amberlite IRA 958 acrylic based ion-exchange medium instead of Spherosil QMA and similar results were obtained.

EXAMPLE 7

The process of Example 2 was repeated except that the whey was contacted with Indion QAE cellulose based ion-exchange medium instead of Spherosil QMA and similar results were obtained.

EXAMPLE 8

Milk Shake drinks were produced using a blend of the following ingredients:

	Comparison	*Example 8*
Skim milk powder	46.5g	46.5g
Icing sugar	42g	42g
Calcium caseinate	7.2g	7.2g
Guar gum	1g	1g
Flavour/colour	1.8g	1.8g
Proteinaceous material	NIL	2.5g
	98.5g	101g

In each case, 50g of the blend was mixed with 130ml cold water and whisked well. The mix of Example 8 containing the proteinaceous material of the invention gave a good foaming head which was stable for over 20 minutes.

The comparison containing no proteinaceous material of the invention foamed initially but the head rapidly collapsed.

EXAMPLE 9

A "Dessert Whip" was produced using a blend of the following ingredients:

Skim milk powder	35g
Icing sugar	32g
Calcium caseinate	5.5g
Guar gum	0.8g
Starch	22g
Flavour/colour	1.5g
Protein product	3.7g

50g of the blend was mixed with 150ml cold water, whisked with a mechanical whisk and left to stand for approximately 3 minutes. The product held air well.

EXAMPLE 10

The emulsifying capacity of the material as prepared in Exampe 1 was compared with that of a whey protein concentrate and a caseinate using the emulsion test as described by N.B. Webb *et al.*, J. Food Science, *35*, 501-504, (1970).

The results obtained show that the emulsifying capacity is improved over that of the whey protein concentrate at all concentrations and is similar to, or better than, the caseinate. The product of Example 1 also showed better dispersibility than the caseinate.

Polyacrylamide gel electrophoresis:

The individual proteins or protein fragments present in the recovered fraction were separated and compared with those of the major proteins in skim-milk and whey using polyacrylamide gel electrophoresis in the presence of 8 *M* urea as described by Anderson and Andrews (Journal of Dairy Research, (1977), *44*, 223-235) and Hillier (*ibid.*, (1976), *43*, 259-265). The protein bands obtained by discontinuous electrophoresis in a 12.5% w/v acrylamide gel using an LKB model 90 01 3124 slab-gel electrophoresis apparatus are shown in Figure 1.

Figure 1 is a photograph of the protein bands obtained after electrophoresis of skim-milk, whey and protein fractions obtained in Examples 1 to 7 using 12.5% w/v acrylamide gels in the presence of 8 *M* urea. The numbered lanes were obtained from the following samples:

Lane

1. Skim-milk (14 ug protein)
2. Whey (5.4 ug protein)
3. Protein fraction obtained after elution of protein adsorbed during the passage of rennet whey through Spherosil QMA using 0.1 *M*-HCl (35 ug protein) (Ex 1)
4. Protein fraction obtained after elution of protein adsorbed during the passage of rennet whey through Spherosil QMA using 1 *M*-NaCl (35 ug protein) (Ex 2)
5. Protein fraction obtained after elution of protein adsorbed during the passage of acid whey through Spherosil QMA using 0.1 *M*-HCl (12 ug protein) (Ex 4)
6. Protein fraction obtained after elution of protein adsorbed during the passage of acid whey through Spherosil QMA using 1 *M*-NaCl (12 ug protein) (Ex 4)
7. Protein fraction obtained after elution of protein adsorbed during the passage of rennet whey through Amberlite IRA 958 medium using 0.1 *M*-HCl (35 ug protein) (Ex 6)
8. Protein fraction obtained after elution of protein adsorbed during the passage of rennet whey through Amberlite IRA 958 medium using 1 *M*-NaCl (35 ug protein) (Ex 6)
9. Protein fraction obtained after elution of protein adsorbed during the passage of rennet whey through Indion QAE medium using 1 *M*-NaCl (35 ug protein) (Ex 7)
10. Protein fraction obtained after elution of protein adsorbed during the passage of a solution containing the proteolytic products of rennet on sodium caseinate through Spherosil QMA using 0.1 *M*-HCl (35 ug protein) (Ex 5).

Note the relative absence of alpha-, beta- and kappa-casein, and bovine serum albumin, alpha-lactalbumin and beta-lactoglobulin in the protein fractions loaded in slots 3-7 even though considerably more protein was applied to the gel.

CLAIMS

1. A proteinaceous material obtained from milk or casein-containing milk products, or an analogue or derivative thereof, comprising a polypeptide or mixture of polypeptides substantially free of native alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins, and which

i) remains in solution at pH 4.6 to pH 5.3 at 20°C;

ii) is anionic at pH 4.6 to pH 5.3; and

iii) forms a gel when an aqueous solution containing at least 12% w/v of the proteinaceous material at 20°C and pH 4.5 or below is allowed to stand for 18 to 24 h.

2. A proteinaceous material according to claim 1 which contains less than 1% each of native alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins.

3. A proteinaceous material according to claim 1 substantially as herein described with reference to any one of the Examples.

4. A proteinaceous material according to claim 1 which, when subjected to polyacrylamide gel electrophoresis as herein described, shows a pattern substantially as herein described and illustrated with reference to any one of lanes 3 to 10 in Fig. 1 of the accompanying drawings.

5. A process for producing a proteinaceous material as defined above which comprises fractionating milk whey or a casein-containing milk product which has been exposed to proteolytic enzymes and recovering fractions containing a polypeptide or mixture of polypeptides substantially free of native alpha-, beta- and kappa-casein, serum albumin, alpha-lactalbumin, beta-lactoglobulin and the immunoglobulins and which

i) remains in solution at pH 4.6 to pH 5.3 at 20°C;

ii) is anionic at pH 4.6 to pH 5.3; and

iii) forms a gel when an aqueous solution containing at least 12% w/v of the proteinaceous material at 20°C and pH 4.5 or below is allowed to stand for 18 to 24 h.

6. A process for producing the proteinaceous material according to claim 5 which comprises the steps of

(a) if necessary, adjusting the pH milk whey to pH 4 to 6

(b) contacting the whey with an ion exchange medium having basic functional groups

(c) eluting protein fractions from the medium

(d) collecting the fractions containing the desired polypeptide or mixture of polypeptides

(e) removing excess eluant from the fractions so obtained and

(f) drying the proteinaceous material so produced.

7. A process according to claim 6 wherein rennet coagulated whey is employed.

8. A process according to claim 6 or claim 7 wherein the whey is pasteurised before being contacted with ion exchange medium.

9. A process for producing the proteinaceous material according to claim 5 which comprises the steps of

a) treating resuspended casein or caseinate with proteolytic enzymes,

b) adjusting the pH of the product of step a) to pH 4 to 6,

c) removing any precipitated protein,

d) if necessary adjusting the pH of the remaining solution to pH 4.8 to 5.3,

e) contacting the solution with an ion exchange medium having basic functional groups,

f) eluting protein fractions from the medium,

g) collecting the fractions containing the desired polypeptide or mixture of polypeptides,

h) removing excess eluant from the fractions so obtained and

i) drying the proteinaceous material so produced.

10. A process according to any one of the claims 6 to 9 wherein the ion exchange medium is eluted with hydrochloric acid or sodium chloride in aqueous solution.

11. A process according to claim 10 wherein the ion exchange medium is eluted with 0.1 to 0.2 *M* hydrochloric acid or 1 *M* sodium chloride solution.

12. A process according to any one of claims 6 to 11 wherein the ion exchange medium is washed prior to elution.

13. A process according to claims 6 to 12 wherein the protein fractions collected from the ion exchange medium are diafiltered for removal of remaining eluant.

14. A process according to claim 13 wherein the protein fractions collected from the ion exchange medium are concentrated by ultrafiltration or thermal evaporation.

15. A process according to claims 6 to 14 wherein the protein fractions collected from the ion exchange medium are concentrated by ultrafiltration.

16. A process according any one of claims 6 to 15 wherein the proteinaceous material is spray dried or freeze dried.

17. A process according to claim 16 wherein the proteinaceous material is spray dried.

18. A process according to claim 5 and substantially as herein described with reference to any one of Examples 1 to 7.

19. A milk protein fraction whenever produced by a process according to any one of claims 5 to 18.

20. A food or drink product comprising, as thickening, gelling, emulsifying, stabilising or whipping agent or as a protein supplement, a protein fraction as claimed in any one of claims 1 to 4, and 19.

21. A food or drink product as claimed in claim 20 and substantially as herein described with reference to Examples 8 and 9.

22. A process for thickening or gelling a food or drink product comprising admixing a proteinaceous material as claimed in any one of claims 1 to 4 and 19 or an aqueous solution thereof, with other ingredients of the food or drink product the aqueous phase of which has a pH or 4.5 or less.

23. A process for emulsifying or stabilising a food or drink product comprising admixing a sufficient quantity of a proteinaceous material as defined in any one of claims 1 to 4 and 19 with other ingredients of a food or drink product the aqueous phase of which has a pH of over 4.5.

24. A process for producing an aerated food or drink product comprising admixing a sufficient quantity of a proteinaceous material as hereinbefore defined before or at the same time as the product is whipped or otherwise aerated to form a foam.

25. A process according to claim 24 for producing a milk shake or dessert whip.

26. A process according to claim 24 and substantially as hereinbefore described with reference to Example 8 or Example 9.

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